An Empirical Examination of the Relationship between Spot and Derivatives Market in India

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An Empirical Examination of the Relationship between Spot and Derivatives Market in India

1. Introduction

One of the common characteristics of all financial markets is 'risk'. Due to the interaction of demand and supply forces, variations in the prices of underlying assets take place over a period of time. The liberalization, privatization and globalization have caused the remarkable increase in the volume of international trade (Obstfeld and Taylor (2003), Shah and Patnaik, 2011)). As a result of increased international trade and movement of men, materials and money, the exchange of currencies of the world has witnessed the surge in the volumes. The world has also witnessed an unprecedented rise in the prices of commodities from the beginning of the 21st century. The developments in the developed countries have led to the weakening of the world economies which have experienced a prolonged recession. The global financial crisis has added to the woes of the developed as well as the developing countries. These developments have resulted in variations in the exchange and interest rates, which in turn have led to the variations in the prices of financial market instruments. The businesses of today have been experiencing much more uncertainty than those of the past. The different types of risks that the businesses face today threaten to turn a profitable organisation into loss making one. Naturally, the need for the search of risk management tools to hedge against uncertainty took the momentum. Today's businesses have to live with different types and levels of risks and therefore, these risks have to be managed. Derivatives are one of the risk mitigating instruments which can effectively transfer or reduce risk caused by uncertainty or volatility.

Hull (2009) defines, derivative as "a financial instrument whose value depends on (or derives from) the values of other, more basic, underlying variables". Therefore, derivatives are such instruments which do not have their own value, but their value depends on the underlying assets which may be financial assets or non- financial assets.

The first derivatives contracts are generally traced to the Yodova rice market in Osaka, Japan, around 1650s and the first exchange for trading derivatives appeared to be the Royal Exchange in London, which permitted forward contracting (Chance, 1998). The next major event in the history of derivatives was the creation of Chicago Boart of Trade (CBOT) in 1848. In the year 1865 CBOT listed the first exchange traded derivatives in the USA which were called as futures contract. Then in 1919, the Chicago Butter and Egg Board, a spin-off

of the CBOT, was recognized to allow futures trading whose name was subsequently changed as Chicago Mercantile Exchange (CME). In April 1973, the Chicago Board of Options Exchange was set up for the trading exclusively on options. Subsequently, the derivative trading spread to the entire world and several exchanges were set up for the trading and regulation purposes.

In India, the Securities and Exchange Board of India (SEBI) permitted trading in index based derivatives on stock exchanges in June 2000. As a result, the Stock Exchange, Mumbai, popularly known as the BSE Ltd (BSE) and National Stock Exchange of India Ltd. (NSE) introduced trading in index futures on June 9, 2000 and June 12, 2000, respectively. It was then followed by trading in index options on June 1, 2001 on BSE. The NSE introduced trading in Index Options (based on Nifty) on June 4, 2001. NSE became the first exchange to launch trading in options on individual securities from July 2, 2001. BSE started stock options and single stock futures (31 stocks) on July 9, 2001and November 9, 2002, respectively. On November 9, 2001, NSE started futures on individual securities. At present NSE has become the market leader in the index and stock futures and options section. Approximately, 92 percent of the total trading value of NSE came from the derivative segment in the year 2013-14 (NSE fact book-2014 p 03). The futures and options (F&O) segment of the NSE outperformed the cash market segment with an average daily turnover of Rs 1, 52,236.69 crores, against Rs 11,191 crores in the cash segment in 2013-14 (www.nseindia.com).

The above developments of financial derivative instruments have emerged as perhaps the most significant aspect of capital markets in last 20 years. Exchange traded and over-the - counter derivatives have radically altered the practice of borrowing, investment and risk management. The changes affect the fundamental nature of financial activities and the manner in which financial transactions are undertaken. The availability of derivative instruments provides benefits to market participants. These benefits include the ability to manage the price exposure and create exposure synthetically to assets. There are additional benefits in terms of enhancing the liquidity of the underlying asset markets and in reducing the volatility of asset prices. These benefits enhanced the attractiveness if investment (both direct and portfolio) in asset markets (Das, 2006).

2. Review of Literature

The derivatives products have been studied by different scholars across the globe from different angles. Available evidence on financial derivatives can be divided into four broad areas:

- Impact of derivatives on spot market volatility
- Lead-lag relationship (reflected in price and non-price variables) between futures and spot market and price discovery process
- Optimal hedge ratio and hedging effectiveness
- Impact of information and expiration effects.

2. 1. Derivatives trading and its impact on the spot market:

The effect of introduction of futures trading activity on their respective spot market is a most debatable issue. A number of studies have been carried out over the world to capture the implications of derivatives trading on its spot market. Studies focused on issues like the effect on returns, volatility, news and information assimilation and price discovery. All these studies failed to give a clear conclusion. The results were mixed in nature. Simpson and Ireland (1982) and Bortz (1984) analysed the impact of future trading on Treasury Bills spot market. The former found that in the short run the volatility in the spot market is reduced but it increased in the long run. Whereas the latter concluded that volatility in spot market reduced irrespective of time. Edwards (1988) and Harris (1989) compared the variation in the returns in pre and post futures period for the S&P 500 index. Edwards (1988) found that existing volatility did not change in the long run. Volatility increased after the introduction of futures trading in S&P 500 (Harris, 1989). Hogdson and Nicholls (1991) studied this issue for All Ordinary Share Index (AOI) by comparing the standard deviation of daily and weekly returns and came out with the result that the introduction of futures and options trading have not affected the long term volatility of the spot market.

Jagdeesh and Subrahmanyam (1993) compared the bid ask spread before and after the introduction of futures trading for S&P 500 and concluded that introduction of index futures did not reduce spreads in the spot market. Similarly, for S&P 500 and Major Market Index (MMI) Chol and Subrahmanyam (1994) found that the average intraday bid ask spread in post MMI futures has increased and no significance change in volatility in the spot market.
Dennis and Sim (1999), Butterworth (2000) and Rahman (2001) analyzed the effect of introduction of futures trading on Sydney Futures Exchange, FTSE- Mid 250 exchange and DJIA respectively by using GARCH related models. These studies showed that there is no

impact on the existing conditional volatility after introduction of futures trading. Using the same methodology Benilde and Armada (2001) and Pok and Poshakwale (2004) found an increase in volatility in the post derivatives period in the Portuguese stock market and Malaysian stock market respectively.

Pilar and Rafael (2001) studied the Italian stock market collecting data from IBEX-35 using GJR Model and found that the volatility of the underlying index declined after derivatives markets were introduced. Similar result was obtained by Figuerola and Gilbert (2001) who used Error Correction Model and GARCH (1, 1) model for Aluminium of London Metal Exchange (LME). Bologna and Cavallo (2002), Drimbetas, Sariannidi and Porfiris (2007) and Kasman and Kasman (2007) also found a reduction of spot market volatility onset of derivatives.

In Indian context, several studies were conducted to capture the effect of derivatives trading on spot market. Gupta (2002), Thenmozhi (2002), Tiripalraju and Patil (2002), Nath (2003), Raju and Karande (2003), Bandivadekar and Ghosh (2003), Hetamsaria and Swain (2003), Apte (2003), Nupur and Saikat (2004), Mallikarjunappa and Afsal (2007, 2008), Sakthivel and Kamaiah (2011) are the leading studies. There are three similarities among these studies: first, all these authors studied either BSE or NSE, second, they used GARCH related models to capture the conditional volatility and third, all these authors concluded that the volatility in the spot market declined after the introduction of derivatives trading. However, Rao (2007) found that volatility has increased for S&P CNX Nifty in the post derivatives period. His study covered the period from June 1999 to December 2005 for S&P Nifty and Nifty 500. He used ordinary linear regression and compared the variation in returns before and after introduction of derivatives. Gurpreet (2007) studied the same issue on commodities from NCDEX. He used GARCHX and Forecast error variance decomposition and reported no significant change in the spot price volatility.

2.2. Lead-lag relationship and role of derivatives in price discovery:

As far as the temporal relationship between the spot and derivatives market is concerned, several studies attempted to examine the lead-lag relationship between the spot and the futures market both in terms of return and /or volatility. These studies have concluded that there is a significant lead-lag relationship between the spot and the futures market, and also have tried to provide the possible explanation behind this. Most of the studies have suggested that the leading role of the futures market varies from five to forty minutes, while the spot market rarely leads the futures market beyond one minute.

The very early study in this regard can be attributed to Gardbade and Silber (1982). They investigated the lead-lag relationship between the four agricultural commodities, wheat, corn, orange juice and oats. This study dealt with the correlation of lagged basis (difference between spot and futures prices) with present spot and/or futures prices. The study found a dominating role of futures market for wheat, corn and orange juice and for oats the study did not find any lead-lag relationship. Using causality tests Brorsen, Bailey and Richardson (1984) analysed the dynamic relationship between the spot and futures prices of cotton market from Lubbock, Texas, for the period from June 1976 through April 30, 1982. This study found that the cotton futures market is leading the spot market and prices of cotton are first discovered in the futures market. Kawaller, Koch and Koch (1987) estimated the lead-lag relationship between the index spot and futures market of S&P 500 using the simultaneous equation model (SEM). This study found that the S&P 500 index futures market takes a leading role over its underlying spot market. More precisely, they reported that the leading behaviour of the futures markets stretches between 20 and 45 minutes, while in opposite direction the lead of spot market do not extend more than one minute. Chan (1992) studied the intraday lead-lag relationship between the Major Market (MM) spot index and MM futures index over two sample periods; August 1984 through June 1985 and January 1987 through September 1987. This study found that there exists an asymmetric lead-lag relationship between the markets. This study found strong leading role of futures market over the spot market.

For All Ordinaries Index (AOI) of Australia, high frequency cause-effect relationship was analysed by Turkington and Walsh (1999). In this study clear bi-directional causal relationship is found between the spot and futures market. VAR, Impulse Response Function and ARMA (p,q) models are used for identification of lead-lag relationship. A strong feedback relationship is observed between the spot and futures market. Min and Najand (1999) using 10 minute intraday data studied the lead- lag relationship in return and volatility of Korean stock and futures market. The sample period covers from May 3, 1996 to October 16, 1996. They applied the structural equation method (SEM) which is extensively used on Granger causality test and Vector Auto-regression model and found that previous futures returns influence more on current cash market return than the reverse direction. Frino, Walter and West (2000) analysed the lead-lag relationship between the returns on a stock index and stock index futures contract around the macroeconomic and stock specific information release. The study used daily data of AOI and SPI index of Australia for the period from 1 August 1995 to 31 December 1996. This study documents that the index

futures market leads over the spot market around the macro-economic information. However, around the release of stock specific information the leading role of futures market declines and feedback from spot market increases. Raju and Karande (2000) analysed the issue of price discovery and lead-lag relationship for Nifty index futures and underlying spot market. They applied the co-integration and GARCH models for the analysis purpose and found that spot market influences over the futures market and the futures market corrects itself to maintain the equilibrium price level. Hence, informed traders are very active in Nifty index spot market than the futures market. Gwilym and Buckle (2001) examined the lead-lag relationship between the FTSE100 stock market index and its futures and options. A multiple regression model where along with the dependent variables such as spot, futures call and put; error correction term is included. Results found that derivatives products lead the stock market.

Floros and Vougas (2007) examined the lead-lag relationship between the spot and futures market of Greece for the period two years from 1999 through 2001. Bivariate-GARCH model is employed particularly for the index futures contracts of Athens Derivatives Exchange (ADEX). This study confirmed the presence of long term relationship and lead-lag relationship between the markets under study and futures market is more efficient which collects information content quickly and leads over the spot market in price discovery process.

Debasish and Mishra (2008) studied the lead-lag relationship between the NSE Nifty spot index and its derivatives market. Hourly data has been used for a period of six years and through multiple regression techniques the contemporaneous relationship is studied. This study found that both futures and options market significantly lead the spot market. Karmakar (2009) investigates the daily price discovery and volatility spill-over process between the Nifty index spot and futures market using VECM and BEKK models. VECM results indicates that Nifty futures dominate the spot market in price discovery and BEKK model found that though there is bidirectional volatility spillover, futures market is stronger than the spot market. Srinivasan and Ibrahim (2009) examined the price discovery process and volatility spillover in gold futures and spot market of NCDEX index of India. VECM and ECM-EGARCH (1, 1) models are used for the analysis. This study found that gold spot market plays significant role over futures market in price discovery.

Athanasios (2010) examined the dynamic relationship between the spot and futures FTSE/ASE-20 index of Greece. The sample comprised 2100 trading with 4200 observations. GARCH (p, q) and Granger Causality models are used and found feedback relationship

between the markets. Mallikarjunappa and Afsal (2010) applying the concept of co-integration and VECM-EGARCH model studied the lead-lag and price discovery on select stocks traded on NSE. They used intraday data observed at five minutes interval for the period about six months starting from July 3, 2006 to December 28, 2006. This study rejected the presence of lead-lag relationship and concluded that there is a contemporaneous and bidirectional relationship between the spot and futures market. They found that none of the market leads or lags in price discovery instead price discovery occurs in both the market at the same time.

For the lean hogs and pork bellies markets Jackline and Deo (2011) studied the lead-lag relationship during the sample period from January 2001 to May 2010. Granger causality test was employed and this study found that there is bidirectional causal relationship and no market leads or lags in the price discovery process. Kumar and Pandey (2011) investigated the price discovery role of the Indian commodity market. Return and volatility spillover is examined using VAR and VECM models for the select commodities of Multi Commodity Exchange of India Ltd (MCX) index and National Commodities and Derivatives Exchange of India Ltd. (NCDEX) index of India. This study failed to give a clear answer for the lead-lag relationship since the Indian commodity market is not established and suffer from the problem of thin trading volume. However, in most of the commodities futures market seemed to be take leading role over spot market. Srinivasan (2011) studied the price discovery and volatility spillover in the Indian commodity spot and futures market using the four major commodity indices of India; MCXCOMDEX, MCXAGRI, MCXENERGY and MCXMETAL. The sample period spans from June 8, 2005 to November 30, 2010 and the concepts of Johansen's co-integration, VECM and ECM-EGARCH have been used for the analysis. This study found that spot market dominates the futures market and serves as an effective price discovery vehicle. Mukthar and Arunachalam (2011) studied the price discovery and causality in Indian stock market using the VECM framework. CNX Nifty Index and Index futures of NSE have been studied for the period of eight years from June 12, 2000 to November 10, 2008. They found that price discovery happens in both the markets simultaneously. Hence, there exists bi-directional relationship between the index spot and futures markets.

Choudhary and Bajaj (2013) analyzed the lead-lag and price discovery relationship between the spot and futures market of 41 securities that are listed in NSE and NSE Nifty index itself. Co-integration and VECM models are applied for the daily data of ten years sample period. This study reported that in case of 21idividual stocks and Nifty index there is

a leading role of futures market, in case of 20 stocks spot market leads the futures market. Ekta (2013) using the intraday data of Bank-Nifty index spot and futures studied the lead-lag relationship between the two markets in India. Co-integration and Granger causality test has been employed and the study concluded that spot market is powerful and takes leading position in price discovery. Sehgal, Rajput and Deisting (2013) studied the lead-lag and price discovery issue on twelve commodities traded in MCX and four commodity indices. This study found that the futures market is leading in the price discovery process in case of eight individual commodities and three commodity indices. Vasantha and Mallikarjunappa (2015) found that the spot market is imformationally efficient and leads over the spot market in the price discovery process in the Indian commodity market.

2. 3. Impact of information and expiration effect on spot prices:

A theoretical hypothesis introduced by Samuelson (1965), known as the Samuelson hypothesis (SH) or the time-to-maturity effect (TTM), develops a model predicting a rise in the volatility of futures prices as maturity nears. Many authors tried to verify this hypothesis in several stock and commodity markets. Milonas (1986) tested the hypothesis that the price variability increases as time to maturity nears for 11 commodities. He calculated price variability as variance over daily price changes within a month and record the number of months left to maturity for that contract. He found a mixed result that for 3 financial assets SH holds true and for the rest of agricultural and metal futures very weak evidence was found. Galloway and Kolb (1996) studied the maturity effect by examining more extensive set of futures contracts for more commodities using data on 4111 futures contracts drawn from 45 commodities over the years from 1969 to 1992, and employing an alternative methodology to control for the effects of year, calendar month, and contract month. Strong support was found for the maturity effect in agricultural and energy commodities.

Chen, Duan and Hung (1999) studied the volatility and maturity effects of Nikkei-225 index. A bivariate GARCH model with the maturity effect is employed to model the joint dynamics of the spot index and the futures-spot basis. Their results show that both the maturity and GARCH effects are simultaneously present. Hong (2000) develops an equilibrium model of a competitive futures market where investors trade to hedge positions and to speculate on their private information. He examines the equilibrium return and trading patterns and concludes that in markets where the information asymmetry among investors is small, the return volatility of futures contract decreases with time-to-maturity, that is, the Samuelson hypothesis holds.

Vicent and Fernandez (2002) studied the expiration of Spanish spot and futures market (IBEX-35 index and its futures) using bivariate error correction GARCH (ECM-BGARCH) models, which included dummy variables representing the days until expiration, both in the equation of the mean and in the conditional variance. To model conditional volatility, the EGARCH model (Nelson, 1991) was used. The results showed that, during the week of the expiration day, the conditional variance of both markets increases without presenting any significant behavior in the correlation level. During the second week, however, the conditional variance diminishes and the degree of correlation between both markets increases. Rita (2003) investigated the maturity effect in the futures market for eleven financial futures markets (Currencies, S&P500, Nikkei 225, Eurodollar and Treasury Bills). The basic GARCH Model was augmented by a time-to-maturity variable and two economic variables, open interest and trading volume , in order to determine their relative contribution to the conditional variance. This study supported Samuelson hypothesis and detected a strong time-to-maturity effect for currency futures.

Alkeback and Hagelin (2004) examined index futures and options expiration day effects on the Swedish market. While the results for the period 1988-1998 indicated that trading volumes on the cash market were significantly higher on expiration days than on other days, no evidence suggesting that price distortions occurred was found. Daal and Farhat (2004) using 6805 futures contracts drawn from 61 commodities, including some data from non-US markets, found that the maturity effect was absent in the majority of contracts. In addition, the maturity effect tends to be stronger in agricultural and energy commodities than in financial futures. Duong and Kalev (2006) considered the Samuelson hypothesis in futures market, utilizing intraday data from 20 futures markets in six futures exchanges and a strong support for the Samuelson hypothesis in agricultural futures was obtained. However, the Samuelson hypothesis did not hold for other futures contracts. Chou et al. (2006) found significant expiration effects on the expiration day for TAIFEX index derivatives in the study between 1998 and 2002. A general comparison showed that the expiration effects in Taiwan are not as significant as those in the U.S. markets, but are stronger than those in Hong Kong market. Gurrola and Herrerias (2007) investigated the relationship between volatility and contract expiration for the case of Mexican interest rate futures. Using panel data techniques, the study assesses the differences in volatility patterns between contracts. The results show that although the maturity effect was sometimes present, the inverse effect prevails; volatility decreases as expiration approaches.

Majority of the Indian studies regarding expiration effect have been done on S&P CNX Nifty index and its futures. Badhani (2005) examined how expiration affects the price, volume and volatility of the cash market using GARCH Technique. The result suggested that there is a significant effect of expiration day on price and volume of the cash segment. The volume of the trade increases before and on expiration day perhaps due to increased selling pressure from the arbitrageurs who liquidate their position. Similar result was obtained by Bose and Bhaumik (2007) for S&P CNX Nifty using similar methodology. Jindal and Bodla (2007) analyzed the effect of expiration of stock derivatives on the volatility and marketability of Indian stock market as well as the underlying individual stocks. The results presented that the expiration days of financial derivative witnessed an abnormally high volume trading which was attributed to arbitrage activities in the market.

Pati and Kumar (2007) investigated the Samuelson hypothesis, taking Nifty Index futures. Univariate GARCH, EGARCH family models were used for empirical purpose. The conditional variance was modified and expanded by including TTM, open interest and trading volume as exogenous explanatory variables. The empirical evidence suggested that there is time varying volatility, volatility clustering and leverage effect in Indian futures market. This study did not find evidence for the Samuelson Hypothesis.

Verma and Vijaykumar (2010) examined the maturity effect (Samuelson Hypothesis) in the Indian commodities futures market (NCDEX). In this study, each contract was examined individually for the maturity effect and for the negative covariance between the spot price and net carry cost. It has been observed that the maturity effect is present in nearly half of the contracts. The negative covariance between the net carry cost and spot price for pepper contracts is comparatively less as compared to what is generally observed in the agricultural commodities. Sangeeta (2010) concluded that expiration week effect on volatility of the spot market is more predominant than expiration day effect for NSE Nifty market.

2. 4. Optimal hedging ratio and hedging effectiveness:

Various studies on the estimation of optimal hedge ratio and hedging effectiveness have been carried out across the world. In this section we discuss some of the important studies in this field. Figlewski (1984) calculated the risk and returns combinations of different portfolios underlying five major stock indices that could have been achieved by using the S&P 500 stock index futures as a hedging instrument for the period June 1982 to September 1983. The risk minimizing hedge ratios were estimated by OLS on historical spot and futures

returns. He found that for all indices represented diversified portfolios ex post Minimum Variance Hedge Ratios (MVHR) were better than the beta hedge ratios.

Junkus and Lee (1985) used three stock index futures for Kansas City Borad of Trade, New York Futures Exchange and Chicago Mercantile Exchange and tested the adoptability of four futures hedging models such as, a variance-minimizing model introduced by Johnson (1960), the traditional one to one hedge, a utility maximization model developed by Rutledge (1972), and a basis arbitrage model suggested by Working (1953). Then an optimal ratio (or decision rule) is estimated for each model, and measures for the effectiveness of each hedge were developed. Lee, Bubnys and Lin (1987) tested the temporal stability of the minimum variance hedge ratio. He found that the hedge ratio increases as maturity of the futures contract nears.

Cecchetti, Cumby and Figlewski (1988) derived the hedge ratio by maximizing the expected utility. A third-order linear bivariate ARCH model was used to get the conditional variance and covariance matrix. A numerical procedure is used to maximize the objective function with respect to the hedge ratio. It was found that the hedge ratio changes over time and is significantly less than the MV hedge ratio (which also changes over time). Certainty equivalent is used to measure the effectiveness. They concluded that utility-maximizing hedge ratio performs better than the MV hedge ratio.

Myers and Thompson (1989) suggested a regression approach where the cash price level is regressed against the futures price level plus a set of conditioning variables and suggest the conditioning variables include lags of futures and cash prices, plus any variables thought to influence prices such as stocks, exports, and storage costs. In an example using corn and soybeans, the authors show that the generalized optimal hedge ratio can vary substantially from the unconditional ratio estimated with price levels; but, they argue that the unconditional ratio estimated with price changes may provide a reasonable estimate of the generalized hedge ratio. Ghosh (1993) by using an Error Correction Model (ECM) argued that the standard OLS approach is not well specified in estimating hedge ratios ratio (for the S&P 500, NYSE composite index, but not the DJIA index) because it ignores lagged values. Holmes (1996) showed that in terms of risk reduction a hedge strategy based on MVHRs estimated using OLS outperforms optimal hedge ratios that are estimated using more advanced econometric techniques such as an error correction model or a GARCH (1,1) approach.

Chou, Denis and Lee (1996) estimated and compared the hedge ratios of the conventional and the error correction model using Japan's Nikkei Stock Average (NSA) index and the NSA index futures with different time intervals for the period 1989-1993. Examining an out-of-sample performance, they found that the error correction model outperformed the conventional approach, while the opposite position was true when the in-sample portfolio variance was evaluated. Lypny and Powalla (1998) examined the hedging effectiveness of the German stock index (DAX) futures and showed that the application of a dynamic hedging strategy based on a GARCH (1, 1) process is economically and statistically most effective model. Butterworth and Holmes (2001) investigated the hedging effectiveness of the FTSE-Mid 250 stock index futures contract using Least Trimmed Squares approach to estimate hedge ratios, their results showed that FTSE-Mid 250 stock index futures contract is superior to the FTSE-100 index futures contract when hedging cash portfolios mirroring the Mid250 and the FT Investment Trust (FTIT) indices.

Baillie and Myers (1991) investigated the optimal hedge ratio for six different commodities, and applying bivariate GARCH. Estimated OHRs are found to vary over time so that the usual assumption of constant OHRs is inappropriate. In particular, the OHR for each of the six commodities contains a unit root and therefore behaves much like a random walk. Hedging performance tests indicated that the assumption of a constant hedge ratio is quite costly (in terms of a higher return variance) for some commodities, but not for others.

Kavussanos and Nomikos (1999) conducted a unique and supposedly the first study on constant vs. time-varying hedge ratios and hedging efficiency in the Baltic International Financial Futures Exchange (BIFFEX) market. The authors modeled the spot and futures returns as a vector error correction model (VECM) with a GARCH error structure. In- and out-of-sample tests are employed to assess the effectiveness of the futures contract. The tests revealed that GARCH-X specification provides greater risk reduction than a simple GARCH and a constant hedge ratio. Park and Switzer (1995) examined the risk-minimizing futures hedge ratio for three types of stock index futures, S&P 500 Index Futures, Major Market (MM) Index Futures and Toronto 35 Index Futures. Using a bivariate co-integration model with a generalized ARCH error structure they estimated optimal hedge ratio as a ratio of the conditional covariance between spot and futures to the conditional variance futures. Both within sample comparisons and out-of-the sample revealed that the dynamic hedging strategy based the bivariate GARCH model improves the hedging performance over the conventional constant hedging strategy.

Kroner and Sultan (1993) combine the error-correction model with the GARCH model considered by Cecchetti et al. (1988) and Baillie and Myers (1991) in order to estimate the optimum hedge ratio for five currencies. They demonstrated a method of calculating the risk minimising futures hedge that address the downward bias in $\hat{\beta}$and the assumption leading to imply that the risk-minimising hedge ratio is time varying. Due to the use of conditional models, the time series of the MV hedge ratios are estimated. Both within-sample and out-of-sample evidence shows that the hedging strategy proposed in the paper is potentially superior to the conventional strategies.

Bhaduri and Durai (2008) investigated the optimal hedge ratio and hedging effectiveness of S&P CNX Nifty index futures by employing four models such as OLS, VAR, VECM and multivariate GARCH model. Their results revealed that the time varying M-GARCH performs better in the long run whereas OLS is best in the short duration. A similar kind of study was conducted by Kumar, Singh and Pandey (2008) by including Nifty index and three commodities and their results revealed that time varying hedge ratio performs better than the constant hedge ratios. Gupta and Singh (2009) estimated the optimal hedge ratio for the Indian derivatives market through the examination of three indices viz. Nifty, Bank Nifty and CNX IT, and 84 most liquid individual stock futures traded on the National Stock Exchange of India Ltd. The results suggested that hedge ratio calculated through VAR model or VEC Model performs better and this is due to the presence of co-integration between spot and futures markets. Srinivasan (2011) found that the conventional OLS regression method generates better than VAR, VEC and GARCH in terms of variance reduction for the in-sample hedging performance. His study found that VEC Model outperformed the other hedging models for the out-of –sample period in terms of minimizing the risk.

3. Research Gap and Problem Statement

As mentioned in the introductory part it is found that derivatives trading have become finest instruments for risk hedging and speculative dealings. Consequently, a large number of studies conducted on these instruments all over the world, both developing and developed economies. Extensive research has been carried out on certain issues of derivatives like the impact of introduction of derivatives trading on the spot price volatility of the underlying asset, efficiency in price discovery and lead-lag relationship and so on. Researchers also focused on the areas like maturity effects, derivatives as an effective hedging instrument (optimal hedge ratio). The methodologies adopted for the analysis purpose were the GARCH

Family models, co-integration tests, causality tests etc. As a new effort a few authors tried wavelet analysis methods though this is in nascent stage [For example, Lein and Shreshsta (2007), In and Kim (2006)].

In Indian context, derivatives have become an interesting area for researchers since introduction of derivative trading in June 2000. Impact of derivatives on the spot market, especially the impact of futures trading on its underlying instrument's spot market volatility, has been studied by different authors. However, most of Indian studies clustered around the time period from 2000 to 2005. Further, the majority of Indian literature mainly focused on index futures and stock futures. A few authors showed interest in the field of commodity derivatives [for example Karande (2006), Lokare (2007), Rao and Thakur (2008), Kaur and Rao (2010)], and currency derivatives [for example, Mishra and Behrera (2006), Anand and Kaushik (2008)]. The results of these foreign as well as Indian studies are mixed and there is enough scope for further study by including more data and time frame. There is no definite study on the overall performance of derivatives trading covering a wide range of commodities as trading in most of them has commenced/picked up only in the recent time (Lokare, 2007). Therefore, further investigation on specific issues like the introduction of derivatives trading in commodities and currencies and their impact on spot prices, hedging efficiency, expiration effects etc. is the need of the day. Since the efficiency of derivative market also contributes to the growth of capital market, the efficiency of the derivatives market, especially in the Indian context, can become useful study and its results will be useful to different stakeholders like the general investors, mutual fund managers, institutional investors, stock exchanges and policy makers.

4. Objectives of the Study

Based on the review of previous literature and the research gap identified, this study seeks to study the relationship between spot and derivatives market of India. Further, the study analyses the information flow from spot to futures and vice versa. This study takes into consideration the stock and commodity derivatives traded in NSE, MCX and NCDEX exchanges. Particularly this study has the following objectives;

- To examine the developments in financial derivatives, its evolution, policy frameworks and working of the derivatives market in India.
- To investigate whether the Indian spot and derivatives markets are co-integrated and have long term relationship among them.

- To verify whether spot market causes the futures market or futures market causes the spot market or both the market causes each other simultaneously.
- To determine the price discovery process between the spot market and the futures market.
- To assess the hedging efficiency of the Indian derivatives market
- To examine the existence of expiration day effects of derivative contracts on underlying assets' price if any.

4. Hypotheses of the Study

With respect to the above mentioned objectives, this study tests the following hypotheses;

H_1: Indian spot and futures markets are co-integrated.

H_2: Indian Spot market causes futures market

H_3: Indian Futures market causes the spot market

H_4: Indian futures market leads the spot market in price discovery.

H_5: Indian spot market leads the futures market in price discovery.

H_6: There is no maturity effect in the Indian futures market.

H_7: Indian futures market effectively reduces the price-risk of spot market.

5. Scope of the Study

The derivatives segment of the capital market is very vast and studying the entire derivatives market in a single stretch is very cumbersome and time consuming. Though the objective of this study is to examine the relationship between the spot and derivatives in India, we concentrate only futures market. We study the spot and futures market of stock and commodities. The study period covers five years from 2009 to 2013. This study uses low frequency end-of-the day (EOD) as well as high frequency data recorded at one minute interval of the stock market. High frequency data cover a period of one year from April 2013 to March 2014. Since the high frequency data is not available for the commodities we use EOD data for the commodities. Again, this study is limited to only near month data set. Only near month data are considered as the market is more active in the near month compared to other months. It would be worth mentioning that this study concentrates on the futures market and hence structural patterns, volatility behavior and persistence of information for stock and commodity futures is considered. The other key determining factors like inflation rate,

foreign exchange rate, the Index of Industrial Production (IIP), Whole Sale Price Index (WPI), Gross Domestic Product (GDP) etc. are not taken into consideration.

6. Data, Sample and Methodology

NSE is the prime stock exchange in India with maximum transparency and regulatory framework. As mentioned in the introduction section, 92 percent of the total trading value of NSE came from the derivative segment in the year 2013-14 (NSE fact book-2014 p 03). Multi-commodity Exchange of India Ltd. (MCX) and National Commodity and Derivatives Exchange of India Ltd. (NCDEX) are two prominent exchanges in India to deal with commodity derivatives. Hence, secondary data collected from the websites of NSE, MCX and NCDEX are used in this study. We concentrate on futures market taking into consideration of both stock and commodity futures. The sample stocks and commodities (including indices) are selected using a few criteria and final sample include 92 individual stocks (with daily data), 4 stock indices (with daily data), 49 individual stocks (with intraday data), 2 stock indices (with intraday data) and 26 commodities (with daily data). For stocks and stock indices we rely on NSE and commodity futures' data are obtained from MCX and NCDEX exchange. Since, commodity indices are not available for trading they are excluded from the study.

We use Augmented Dickey Fuller (ADF) test for checking the stationary nature of variables. Johansen's co-integration tests, Granger causality tests are used for identification of long run relationship and cause-effect relationship between spot and futures market respectively. To examine the lead-lag relationship we use ARCH and GARCH family frameworks. To examine the expiration day effect, an expanded GARCH framework with open interest and volume is used. For the purpose of estimating the hedge ratio and hedging effectiveness, we rely on dynamic hedge ratio models, again based on GARCH family models.

7. Findings and Conclusions

The emergence of financial derivatives is a relatively new phenomena in India context. Since its inception in the early 2000s, it has grown exponentially in terms of trading volume and number of contracts traded. BSE and NSE are the pioneer exchanges to give formal shape for the India derivatives market. The success of stock derivatives paved the way for the emergence of commodity and other derivatives. During the small duration of a decade, the

derivative segment of NSE surpassed the spot market trading. The growth in trading volume of commodity derivatives in the short period of time is also impressive. MCX, NCDEX and NMCE have emerged as the leading exchanges for commodity derivatives.

The exponential growth of the derivatives market attracted the interest of researchers to measure whether derivatives really help the investors to manage the price risk or not. And, as the derivatives are derived from an asset, the nature of the relationship that exists between the spot and derivatives market was also one area of interest for the researchers. While analyzing the previous studies which deal with the relationship between these two markets, we found that a large number of studies are conducted outside India. Within India we have a dearth of studies. Moreover, these studies suffer from a number of shortcomings, mainly the inconclusiveness about the relationship, outdated tools of analysis, very short sample period, studies of only indices, usage of low frequency data set and concentrating on stock derivatives. Due to the above mentioned shortcomings, there is a strong urge for the in-depth study of the Indian derivatives market as a whole especially the relationship in the post crisis period. With this background, this study deals with the relationship between the spot and derivatives market in India. For this study, we choose a sample period of five years from 2009 to 2013. This study is performed in three different angles; firstly, the lead-lag relationship and role of derivatives market in price discovery; secondly, the hedging efficiency of derivatives markets of India and thirdly, the volatility behavior of derivatives market while the contract is moving towards the expiry. For the study purpose several well-known econometric methods are applied which include ADF test, Johansen co-integration test, Granger causality test, VECM-EGARCH, Expanded GARCH (p, q) Diagonal-VECH, Constant Conditional Correlation (CCC) and Diagonal-BEKK. The first hypothesis is tested using three methods, Johansen co-integration test, Granger causality test and VECM-EGARCH. The major findings of the study are,

- The price series are non-stationary and the first log difference series are stationary.
- The spot and futures series are co-integrated and hence there is a long run relationship between the spot and futures market. Therefore, we accept H_1.
- Considering stock and commodities together, a more than 50 percent of stock and commodities exhibit bi-directional causality and hence H_2 and H_3 are accepted.
- No causality in stocks with daily data (reject H_2 and H_3); unidirectional causality from futures to spot in MCX commodities (Accept H_2) and bidirectional causality in NCDEX commodities (Accept H_2 and H_3).

- Clear bidirectional relationship in case of NSE stocks with intraday data (Accept H_2 and H_3).
- Clear unidirectional lead-lag relationship from futures to spot is found in 50 percent of NSE stocks with EOD, in all MCX commodities and in 50 percent of NCDEX commodities. (Accept H_4 and reject H_5).
- Clear unidirectional lead-lag relationship from futures to spot market is found in more than 50 percent of NSE stocks with intraday data (Accept H_4 and reject H_5).
- The influence of the futures market is stronger than the reverse direction in the cases.
- Absence of maturity effect in the Indian futures market and hence accepting H_6.
- Hedging through NSE stocks with EOD provides high hedging effectiveness in all stocks and indices (Accept H_7).
- In case of commodities of both MCX and NCDEX and NSE stocks with intraday data, the hedging effectiveness is very low in all cases (Reject H_7).
- Daily hedging is preferable than the intraday hedging in the stock market.
- Very high hedge ratios in all stocks and stock indices indicating volatile spot market.
- Stock futures hedge ratios are high, whereas commodity futures hedge ratios are low.
- Hedging through individual stock futures and stock index futures fetch similar risk reduction efficiency.
- Portfolio returns after hedging is lesser than the un-hedged positions, both in stock and commodity futures.

The Indian derivatives market is still in budding stage and it is evident that this segment will be highly promising for development in the future. The derivative segment of India, especially the commodity market, is under surveillance of Government, which is an obstacle for the speedy growth. Most of the commodity futures are illiquid. Therefore, the Government and exchanges should undertake extensive awareness programmes to motivate more and more investors, farmers and industrialists in the agriculture sector to participate in derivatives trading. Commodity options and derivatives trading in commodity indices are still out of reach in Indian scenario. Government and other related agencies like SEBI, The Forward Market Commission (FMC), and exchanges can study the pros and cons of options trading in commodities.

This study will thus be helpful in evaluating the performance of financial derivatives markets in India and will become a value addition to the literature of derivatives. The results of this study will be useful for the policy makers, stock exchanges, business houses, fund managers, general investors, etc. There are further opportunities for undertaking future studies in this area. For example, instead of constructing time series using near month data, individual contracts can be studied. Studies on commodity market can be undertaken through the high frequency data set. Along with the futures market data, options can be used so that the results would be more relevant. The related key determinants of volatility like inflation, exchange rate, RBI announcements, Indian Government announcements relating to the capital market, Federal Reserve announcements, IIP, WPI and GDP can be included in the volatility models.

8. Chapter Scheme

The study entitled "An empirical examination of the relationship between spot and derivatives market in India" is coordinated in eight chapters as below:

Chapter-1: Introduction. This chapter deals with the background of the derivatives, Need for the present study, Objectives, Hypotheses, Scope and limitations, Sources and methods used for data collection.

Chapter-2: Indian financial derivatives market – A profile. This chapter deals with origin, growth, trading mechanisms and regulatory framework of the Indian derivatives market.

Chapter-3: Literature Review. This chapter provides an account of Indian and foreign studies related to various facets of the derivatives market.

Chapter-4: Data, Sample and Methodology. Provides detailed explanations about the data and sample used for the study and explains various statistical and econometrics techniques used for the data analysis.

Chapter–5: Empirical results of Lead-Lag relationship and price discovery.

Chapter– 6: Empirical results of optimal hedge ratio and hedging effectiveness.

Chapter– 7: Empirical results of derivatives maturity effect.

Chapter– 8: Presents a summary of the findings and the conclusions of the empirical evidence of this study. Finally, the directions for further research are also given.

9. Research Papers Published In Journal

- T. Mallikarjunappa and Vasantha. G (2013), "Are Betas stable?" AIMS International Journal of Management, Volume 7(1), pp 57-70. ISSN 1939-7011.
- Vasantha G and Mallikarjunappa T (2015), "Lead-Lag relationship and Price discovery in Indian Commodity Derivatives and Spot Market: An example of Pepper", IUP Journal of Applied Finance, Vol. 21, (1), pp. 71-83. ISSN0972-5105.

10. Publications in Edited Book

1. T. Mallikarjunappa and Vasantha. G (2012), "Testing weak form efficiency of Indian commodity futures market", in S. Nagendra and Anil Rao Paila (eds) *Challenges of sustainability & growth in Indian industry*, BMS college of Engineering-Bangalore, India, pp 220-228, ISBN 978-81-8884999-5
2. Vasantha. G and T. Mallikarjunappa (2013), "Lead-lag relationship between the selected agricultural commodities spot and derivatives market in India", In Ravi M Yadahalli and Suresh Chandra Mohan (eds), *Emerging trends in Engineering & Management*, PES Institute of Technology & Management-Shimoga, India, pp 213-217, ISBN 978-81-926416-0-7.

11. Publications in Conference Proceedings

1. Vasantha G, and T. Mallikarjunappa (2013), "A Study of Maturity Effect in Indian Derivatives Market" In Omprakash K. Gupta (ed), *Proceedings of 10th AIMS International conference on managing services in competitive environment*, University of Houston-Downtown, Houston, USA, pp.1639-1647, ISBN: 978-81-924713-1-0.
2. Vasantha. G and T. Mallikarjunappa (2012), "A study of optimal hedge ratio and hedging effectiveness in Indian derivatives market", In Parasuraman and Ullas Rao (eds) *Proceedings of international conference on emerging trends in finance and Accounting*, SDMIMD-Mysore, India, pp 1-21, ISBN-978-81-922146-2-7.

12. Papers Presented In the International and National Seminars/Conference

13.1. International Conferences

1. Vasantha G and T. Mallikarjunappa (2012), " A Study of Optimal Hedge Ratio and Hedging Effectiveness in Indian Derivatives Market" International Conference on Emerging Finance and Accounts, SDM Institute for Management Development, Mysore, Karnataka India, 3-4 August.
2. Vasantha G and T. Mallikarjunappa (2012), "Testing weak form efficiency of Indian commodity futures market" International Conference on Challenges of Sustainability and Growth in Indian industry, BMS College Of Engineering, Department Of Management Studies & Research Centre, Bangalore, India, 20-21 December.
3. Vasantha G and T. Mallikarjunappa (2013), "A Study of Maturity Effect in Indian Derivatives Market" 10th AIMS International conference on managing services in competitive environment, IIM Bangalore India, 6-9 January
4. Vasantha G and T. Mallikarjunappa (2013), "Are betas stable?" 10th AIMS International conference on managing services in competitive environment, IIM Bangalore India, 6-9 January.
5. Vasantha G and T. Mallikarjunappa (2013), "Lead – Lag Relationship and Price Discovery in Indian Commodity Derivatives and Spot Market- An example of Pepper" in the 6th Doctoral Theses Conference (DTC) Series organized by IBS Hyderabad on 26th to 27th of April, 2013.
6. Vasantha G and T. Mallikarjunappa (2013), "Testing Maturity Effect in Indian Commodity Derivatives Market" in 12th Capital Market Conference, Indian Institute of Capital Market, Mumbai, on 19th and 20th December 2013.
7. Vasantha G and T. Mallikarjunappa (2014), "Inter-linkage between Indian Stock, Commodity and Foreign Exchange Market in ICBF 2014 at Indian Business School, Hyderabad on 9th and 10th January, 2014.
8. Vasantha G and T. Mallikarjunappa (2014), "Lead – Lag Relationship and Price Discovery in Indian Stock Market: A Study of Nifty Index Futures and Spot Market using Intraday Data" at the India Finance Conference (IFC-2014) jointly organized by IIM Bangalore, IIM Ahemadabad and IIM Calcutta at IIM Bangalore during 17-19 Dec. 2014.

9. Vasantha G and T. Mallikarjunappa (2015), "Derivatives and Risk Management: A Study of Nifty", at the 12th AIMS International Conference on Management organized by AIMS International at IIM Kozhikode, during 2-5 Jan. 2015.
10. Vasantha G and T. Mallikarjunappa (2015), " Does the Futures Market Lead the Cash Market?", at the 12th AIMS International Conference on Management organized by AIMS International at IIM Kozhikode, during 2-5 Jan. 2015.

12.2. National Conferences

11. Vasantha G and T. Mallikarjunappa (2013), "Relationship between Commodity Spot and Derivatives Market in India", National conference on Indian Capital Market-Recent Trends, Bhandarkar's Arts and Science College, Kundapur, Karnataka, on 16th and 17th , 2013.
12. Vasantha G and T. Mallikarjunappa (2013), "Relationship between the spot and futures market: A study of Gold in India" National conference on Tomorrow's Business Tigers-Best practices to stay ahead, Srinivas Institute of Management studies, Mangalore, India, 10 April
13. Vasantha G and T. Mallikarjunappa (2013), "Lead-Lag Relationship Between the Selected Agricultural Commodities Spot and Futures Market in India" National Conference on Emerging Trends in Engineering & Management, PES Institute of Engineering and Management, Shimoga, India, 1- 2nd March.
14. Vasantha G and T Mallikarjunappa (2014), " The Relationship between Futures and Spot Market: A Study of Indian Stock Market" in the MANEGMA-2014, one day national conference on 'Changing Trends in Management, IT and Social Science', Srinivas Institute of Management Studies, Pandeshwar, Mangalore on 9th April, 2014.
15. Vasantha G and T. Mallikarjunappa (2015), "Risk Management in Banking Sector Stocks: A Study of Select Bank Stocks of NSE" at the National Conference on Indian Banking: Managing Transformation in the Era of Globalization and Information Technology Organized by Dept. of Commerce, University College, Mangalore during 6-8 Jan. 2015.

13. Workshops/Training Programs Attended

1. Attended three day workshop on "Time-Series modelling and Forecasting" organised by the dept. of Economics, Christ University, Bangalore, from 22nd to 24th, October 2012.

2. Attended three day workshop on SPSS for data analysis organized by Dept. of Statistics, Mangalore University on 19th November 2011.
3. Attended one day workshop on use of SPSS in Research Methodology at Srinivas Institute of Management studies, Mangalore on 19th January 2013.
4. Attended one week workshop on Research Methodology for Commerce Researchers at Kuvempu University during 11 to 15 August 2012.
5. Attended ten days workshop on Data Analysis Using Advanced MS-Excel at Department of Business Administration Mangalore University during 21 to 31 December 2012.
6. Attended 3 days workshop on 'Commodity Market and Derivatives Trading' organised by UGC-SAP dept of commerce, Pondichery University, Puduchery on 5th and 6th September 2013.
7. Attended 6 days workshop on Applied Econometrics organised by Dept of Economics, VSK University, Bellary, Karnataka during 18 to 23, November 2013.
8. Attended ICSSR Sponsored 10 days training course on Research Methodology in Social Sciences organised by Centre for Study of Social Exclusion & Inclusive Policy (CSEIP) Mangalore University during 2 to12, August 2013.

14. Research Awards

- T Mallikarjunappa and Vasantha G (2013), "Are betas stable?", 10th AIMS International conference on managing services in competitive environment, IIM Bangalore India, 6-9 January. **Received Third Best Paper Award.**

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